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ABSTRACT

The goal of this study was to determine the effectiveness of the Piedmont Virginia Community College (PVCC) electronics program between 1995-1999 by answering the following questions: (1) did the students find employment in an electronics-related career upon graduation? (2) did they feel that the program provided them with an adequate level of workplace preparation? and (3) what aspects of the program could be changed to better prepare future students for the workplace? Thirty-four of 57 graduates responded to the survey. According to the survey results, approximately 8 of 10 graduates (79.4%) are currently employed in an electronics related career. The mean response of the overall satisfaction of the respondents with the level of workforce preparation was 4.53, which resides between "moderately satisfied" and "very satisfied." The mean satisfaction values in the skills areas of AC and DC circuits, electronic devices, digital electronics and computers indicated that the graduates were "very satisfied," whereas the mean values for electrical machines and electrical control systems/PLCs were significantly lower. Based on the results of the study, several recommendations are made including evaluation of the textbooks, laboratory assignments, laboratory equipment, instruction, and curricular content of the electrical machines and electrical control systems/PLCs courses to improve their transferability to the workplace environment and greater collaboration with the electronics industry. (JA)

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A Descriptive Follow-Up Study of PVCC Electronics Technology Graduates from 1995-1999

Research Report No. 2-2000
March 2000

Piedmont Virginia Community College
Charlottesville, Virginia

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A Descriptive Follow-Up Study Of

Piedmont Virginia Community College

Electronics Technology Graduates From 1995-1999

By

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Research Report No. 2-2000

March 2000

PVCC INSTITUTIONAL RESEARCH BRIEF

Brief No. 2000-4 March 2000

PVCC Electronic Graduates
1995-1999

This brief highlights key findings in *A Descriptive Follow-Up Study Of Piedmont Virginia Community College Electronics Technology Graduates From 1995-1999* (PVCC Institutional Research Report No. 2-00, March 2000) by Mark Fitzgerald, Program Head of Electronics at Piedmont Virginia Community College (PVCC). The study addressed questions related to the employment and perceived level of workforce preparation of PVCC Electronics program graduates from 1995-1999. The study also considered aspects of the Electronics program that could be changed to better prepare future students for the workplace. Of the 57 graduates surveyed, 34 responded for a return rate of 59.6%. Major findings included the following:

- Approximately eight of ten graduates (79.4%) are currently employed in an Electronics related career. Of the graduates that responded as being currently employed in an Electronics related career, 65.5% indicated that a degree was required for the job or promotion.

- Less than two of ten graduates (17.7%) are currently continuing their education at a four-year institution. Therefore, the total percentage of respondents who are currently employed in Electronics *or* who are continuing their education at a four-year institution is 85.3%.

- The overall satisfaction with the level of workplace preparation that the PVCC Electronics program provided was rated by the respondents as between "Moderately Satisfied" and "Very Satisfied," with the value being slightly directed toward "Very Satisfied."

- The level of satisfaction of preparation in several different Electronics skill areas was also rated by the respondents. The mean values in the areas of AC and DC Circuits, Electronic Devices, Digital Electronics and Computers indicated that the graduates were "Very Satisfied." The mean values in the areas of Microprocessors, Test Equipment Usage, Electronic Communications, Troubleshooting Skills, Electrical Machines, and Electrical Control Systems/PLCs indicated that the graduates were "Moderately Satisfied." The mean values for Electrical Machines and Electrical Control Systems/PLCs were significantly lower indicating that these areas may need to be altered to better prepare students for the workplace.

- The survey also showed the current employer listed by the respondent. GE Fanuc Automation was listed as the leading employer of graduates by 29.6% of the respondents, with Litton Marine Systems employing 18.5%. Numerous other companies employed smaller percentages.

The survey found that the graduates responding to the survey who were employed in an Electronics related career earned a minimum income of $20,000, a maximum income of $48,000, and an average income of $31,735.

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CHAPTER I

INTRODUCTION

Piedmont Virginia Community College (PVCC) is located in the historic Charlottesville and central Virginia area. The college serves the citizens of the city of Charlottesville and Albemarle, Fluvanna, Greene, Louisa, Nelson, and part of Buckingham counties. The service area of the college includes the prestigious University of Virginia and a substantial industry base. The industry base includes a telecommunications manufacturer, a major industrial automation manufacturer, a manufacturer of compact disks (CDs), and a manufacturer of navigation systems for the commercial and military markets. With such a diverse service area, the college has a multiple mission that includes college transfer, workforce development, general, and developmental education (PVCC 1999-2000 Catalog and Student Handbook, pp. 1-2).

The college offers several occupational technical programs including Electronics Technology. Electronics Technology is a very dynamic field of study that includes occupations dealing with the installation, maintenance, and repair of computers, consumer electronic products, telecommunications, and industrial control systems. Recent migration of the semiconductor industry to the Old Dominion is also influencing electronics programs statewide.

Nationally, 121,000 job openings for "electrical and electronic technicians and technologists" are projected between 1996-2006 (Bureau of Labor Statistics Employment Projections, 1998). Locally, electronic technicians seem to be in demand within PVCC's service area. Some employers have to recruit electronic technicians from out of state to find enough individuals to meet their needs. With employer demand seemingly high for

electronic technicians, it is essential that the college continually makes sure that the Electronics program graduates are equipped with the skills that they need for the workplace.

STATEMENT OF PROBLEM

The problem of this study was to determine the effectiveness of the Piedmont Virginia Community College (PVCC) Electronics program between 1995-1999.

RESEARCH GOALS

The goals of this study were to answer the following questions:

1. Did the students find employment (or earn a promotion) in an Electronics related career upon graduation?
2. Did the students feel that the Piedmont Virginia Community College (PVCC) Electronics program provided them with an adequate level of workplace preparation?
3. What aspects of the Electronics program could be changed to better prepare future students for the workplace?

BACKGROUND AND SIGNIFICANCE

The researcher has been program head for the Electronics Technology program since the fall of 1993. Substantial resources have been utilized to improve the equipment, materials, and instruction within this program over the last several years. The State Council for Higher Education in Virginia (SCHEV) released this program from

probationary status in 1999. The program was initially on probation mainly due to a low five-year average of graduates from a previous evaluation cycle. Graduate numbers have increased sufficiently over the last several years to meet and exceed SCHEV's minimum productivity requirements. But further information is needed to verify an adequate level of workforce preparedness of recent graduates of the program.

Follow-up studies of all PVCC graduates from the previous May are accomplished at the beginning of each calendar year by the PVCC Office of Institutional Research (IR). Periodic follow-up studies of program graduates give the institution important feedback. But more detailed information specific to the Electronics program graduates is needed. A more favorable return rate on the follow-up studies from Electronics students is also desired. In the 1994-95 follow-up survey, no surveys were returned from the six Electronics program graduates (Griffith & Hassan, 1997, p. 37).

Feedback specific to the Electronics program can be used to verify that students are being provided with the knowledge and skills that employers are seeking. Curricula changes could be implemented based on this feedback. Although the Electronics advisory board input is important when considering any curricula modifications, it makes sense to this researcher that input should be provided from the graduates themselves. This information can also be used to help justify equipment needs and funding so that student experiences at the college will be transferable to the workplace environment.

The community college should serve both the community and industry needs in the institution's service area. This study will provide useful information that will help ensure that the college's Electronics Technology graduates are receiving the skills and knowledge necessary to meet and exceed employer expectations.

LIMITATIONS

Limitations of this research include:

1. The study will focus on degree recipients from Piedmont Virginia Community College.
2. The study will consider PVCC graduates from the time span of 1995-1999.
3. The study will focus on Electronics Technology degree program graduates only.

ASSUMPTIONS

Electronics is a very dynamic field of instruction that involves a continual update of knowledge and skills. The main assumption of this study is that PVCC is doing an acceptable job of preparing graduates from the Electronics program for the demands of the regional workplace.

PROCEDURES

A survey to obtain graduate data was developed by the researcher and subsequently approved by the PVCC Office of Institutional Research. The survey was sent to all graduates of the PVCC Electronics program from the years 1995-1999. The survey instrument asked graduates to respond to questions related to current employment and overall satisfaction with the degree program. The remainder of the survey was dedicated to skill usage on the job in various content areas of the Electronics degree program and how well the graduates felt they were prepared for each. An open-ended comment section was also provided.

The survey was mailed in late September to the last known address indicated on the Student Information System. The survey was mailed with a return envelope addressed to the Office of Institutional Research. The surveys were administered through the Office of Institutional Research as opposed to the researcher's department to avoid any possible biasing of the student's responses. A second mailing was accomplished in mid-October for any non-respondents from the initial mailing. Attempts were made to contact non-respondents by telephone approximately two weeks following the mailing of the second survey. Some students were contacted by telephone shortly after the first mailing to obtain updated addresses.

DEFINITION OF TERMS

Certain terminology in this study may have different meanings to different individuals. Therefore, the following definitions are provided:

1. BLS - Bureau of Labor Statistics. "The Bureau of Labor Statistics (BLS) is the principal fact-finding agency for the Federal Government in the broad field of labor economics and statistics. The BLS is an independent national statistic agency that collects, processes, analyzes, and disseminates essential statistical data to the American public, the U.S. congress, other Federal agencies, State and local governments, business and labor. The BLS also serves as a statistical resource to the Department of Labor" (BLS, 1997).
2. Electrical and Electronic Engineering Technicians and Technologists (OES Code 22505) "Apply electrical and electronic

theory and related knowledge to design, build, test, repair, and modify developmental, experimental, or production electrical equipment in industrial or commercial plants for subsequent use by engineering personnel in making engineering design and evaluation decisions" (BLS OES 1997 National Occupation Employment and Wage Estimates, 1998).

3. Electronics - "the science dealing with the development of devices and systems involving the flow of electrons in a vacuum, in gaseous media, and in semiconductors" (Steinmetz, 1993, p. 211).

4. Follow-up - "something, as a letter or visit, that serves to reinforce the effectiveness of a previous action" (Steinmetz, 1993, p. 256).

5. OES - Occupational Employment Statistics (BLS, 1999).

6. PVCC - Piedmont Virginia Community College; "PVCC is a non-residential two-year state institution of higher education, which operates as part of a statewide system of 23 community colleges. PVCC's service region includes the City of Charlottesville and the Counties of Albemarle, Fluvanna, Greene, Louisa, Nelson, and the northern part of Buckingham" (Charlottesville Regional Chamber of Commerce).

7. SCHEV - State Council of Higher Education for Virginia; "The State Council of Higher Education for Virginia (SCHEV) is the Commonwealth's coordinating body for higher education" (SCHEV Agency Activities, 1999).

SUMMARY AND OVERVIEW

Chapter I has provided the reader an introduction to the problem of the study. The research goals have been established. A brief narrative of where the problem has evolved from and the main benefits of its solution have been provided. The boundaries of the study were fixed. Assumptions of the study were clarified. The procedural steps were illustrated in detail. Terms were defined so that they could be consistently understood by all readers. Chapter I was summarized before looking to the remaining chapters of the study.

Chapter II contains a review of the literature. In Chapter III, the methods and procedures of the study will be discussed. In Chapter IV, the findings of the study will be presented. Chapter V concludes the study by providing a summary, conclusions, and recommendations for the future.

CHAPTER II

REVIEW OF LITERATURE

This chapter will provide a review of the literature in relation to the research goals. To support the aspect of graduates who are employed in a related field of the research goals, information will be provided that illustrates the need for electronics technicians. Workforce preparation issues will then be discussed. Specific aspects of the electronics program at the college will then be discussed.

ELECTRONICS AS A CAREER

Electronics is a very broad field that affects virtually everyone in their daily lives. Rubin reinforces this fact in the following quotation:

> More than ever, electronics touches nearly every aspect of human activity, and its influence is expanding at a near explosive rate. For example, the latest innovations in banking, business, communications, entertainment, finance, industry, medicine, military systems, and transportation all center around electronics devices and systems, and most of those make use of microprocessors or microcontrollers (Rubin, 1997).

With so much technology in use in so many different areas, it is essential that well-trained individuals are prepared to install, maintain, and repair electronic equipment. Individuals can find employment in the Electronics (or related) field working under a variety of different job titles including traditional electrical and electronic technicians and

technologists, data processing (computer) equipment repairers, electronic home entertainment equipment repairers, commercial and industrial equipment electronics repairers, and other electrical and electronic equipment mechanics, installer, and repairers (Bureau of Labor Statistics). To illustrate the amount of money involved in just sales of electronic equipment within the "home" electronics arena, the Consumer Electronics Manufacturers Association (CEMA) forecasts that factory sales of consumer electronics will be slightly less than $80 billion during 1999 (Delano, 1999). According to national BLS projections, there will be a 14.5 percent increase in the need for electrical and electronic technicians and technologists nationally between 1996 and 2006. This represents over 120,000 jobs (BLS, 1998). There is definitely a need for qualified individuals to repair a variety of electronic equipment in many different parts of this diverse industry.

Virginia is certainly not isolated from the popularity of electronics and related industries. Through extensive recruitment efforts at the state level, high technology companies such as Motorola, IBM, and Gateway 2000 have been attracted to Virginia. By 2002, employment in the technology area is expected to exceed 400,000 (Virginia Economic Development Partnership Media Center, 1998).

More specific to the college's region, the Charlottesville Metropolitan Statistical Area (MSA) showed an increase of 3.7 percent in manufacturing employment in 1998 (Bureau of Business Research of the College of William & Mary). A local publication projects that the Greater Charlottesville Region's economic future will be oriented partially towards high technology manufacturing (The Thomas Jefferson Partnership for Economic Development, 1997, p. 55). With the substantial industry base in the

Charlottesville area mentioned earlier, this should come as no surprise.

It should also be noted that a low unemployment rate is forcing some employers to recruit from outside of the state. However, businesses incur more expense when recruiting individuals from out of state (Bureau of Business Research of the College of William & Mary). Since it costs more to "import" electronics technicians from out of state, local businesses and industries see the economic advantages of using the community college to train the existing workforce. Individuals with existing roots in the community are more likely to stay in the area and become long-term employees for many of these companies.

Electronics seems to be a very employable skill in the college's service area. PVCC Institutional Research found from a follow-up survey of 1996 graduates, four out of five graduates from the Electronics program who responded indicated that they were employed full time in a field related to their degree program (PVCC Office of Institutional Research and Planning, 1998, p. 72). But more research needs to be conducted in this area over a longer time span involving a greater number of Electronics Technology graduates.

Becoming an electronics technician also seems to be very financially rewarding. National Bureau of Labor Statistics estimates from 1997 for electrical and electronic engineering technicians and technologists show a mean annual wage of $36,120 (Bureau of Labor Statistics Occupational Employment Statistics, 1998). The same estimate for the state of Virginia shows a higher mean annual wage of $38,040 (Bureau of Labor Statistics Occupational Employment Statistics, 1999).

WORKPLACE PREPARATION

It is extremely important that students are equipped with an adequate level of

workplace preparation when they graduate from their program of study. Employers need entry-level technicians that require a minimum of internal training. The PVCC Electronics degree program has a cooperative education requirement which allows the student to graduate with practical work experience in addition to the usual lecture and laboratory experiences. What is taught in the classroom needs to be transferable to the workplace. The graduates of the program need to feel well prepared for their job duties.

Cohen and Brawer (1989, p. 212) found that "most students in occupational programs seem satisfied with the training they receive." They further add that 80 to 90 percent of follow-up studies yield positive results and cite several examples of studies dealing with different sizes and locations of institutions and systems (Cohen & Brawer, 1989, pp. 213-214). A pilot study at ten community colleges involving over 1,500 students found that more than 77 percent were "satisfied with their community college experience" (American Association of Community Colleges, 1999).

A follow-up study of 1995 graduates from PVCC found that 45.2 percent of the respondents rated their academic preparation for a job as excellent while over 47.9 percent rated their preparation as good (Hassan & Griffith, 1997, p. 46). It should be noted that since none of the Electronics graduates returned their surveys that year, these percentages do not include their input (Hassan & Griffith, 1997, p. 37). Additionally, this 1995 follow-up study at PVCC had the lowest response rate over an eight-year period (Hassan & Griffith, 1997, p. 2). Once again the need for more up-to-date data specifically from Electronics program graduates was needed for proper program evaluation.

ASPECTS OF THE ELECTRONICS PROGRAM

Electronics has greatly matured from the days of vacuum tube radio receivers and room-sized computers. Seymour (1989, p. 31) comments on the need for Electronics programs to have up-to-date equipment and instructors. As earlier mentioned, he echoes the need for good follow-up research on program graduates for placement and performance data. Feedback can be used to help justify equipment purchases and drive changes in curriculum. Seymour concludes by saying that "constant improvement in equipment, teachers, and programs is essential if our country is to produce the workers that will maintain the high-tech equipment of tomorrow."

To help make decisions about any future changes in any program, the current program should be evaluated. One way of accomplishing this is by letting the graduates of this program evaluate their perceived level of preparation in various skill areas in the workplace. Feedback from past graduates applying their skills and knowledge in the workplace could be implemented to help better prepare future graduates. To help accomplish this, the goals and objectives of the program need to be examined.

Referencing the last Electronics Program Review and Evaluation (1994) for specific goals and objectives in the technical areas:

> The Electronics Technology program has as its overall goal the provision of high quality instruction and practical experience necessary to give the student the professional skills needed to secure an entry level position as an electronics technician. The faculty expect the student to:
>
> - understand the principles of AC and DC electricity
> - understand the principles of transformers and AC/DC

machines

- understand the principle characteristics of electronic devices such as resistors, inductors, capacitors, diodes, transistors, integrated circuits, and op-amps
- operate test equipment properly and safely (voltmeters, ammeters, oscilloscopes, signal generators, digital counters, etc.)
- assemble electronics equipment according to schematics and/or sketches
- modify electronic assemblies according to instructions
- diagnose and troubleshoot electronic equipment
- repair electronic equipment once a malfunction has been diagnosed
- assist in designing, building, and testing circuits using solid state devices and integrated circuits
- assist in operating and debugging microprocessor equipment with programs in assembly language
- assist in solving engineering problems using BASIC language

The survey instrument will have a section where the graduates indicate their perceived level of preparedness for the workplace in various skill areas. The skills areas on the survey were correlated with the areas within the program goals and objectives.

SUMMARY

The first part of this chapter was concerned with establishing the importance of and need for electronics technicians at the national, state, and local level. The importance of up-to-date information about PVCC Electronics Technology degree recipients and current employment related to their field of study was also emphasized.

The second part of this chapter dealt with the satisfaction of graduates in relation to their level of workplace preparation upon graduation. More up-to-date information needs to be collected from graduates of the Electronics Technology program to determine

their perceived level of academic preparation for the workplace.

The third part of this chapter was concerned with specific aspects of the skills areas within the current Electronics Technology program. Issues directly related to the construction of the survey instrument were also discussed. Specific skill areas and their related level of job preparation will be evaluated on the survey by graduates of the program.

This study will provide more detailed information specific to the Electronics Technology degree recipients who completed the program in the last five years. Past "generic" institutional research surveys have not been focused toward Electronics Technology graduates and have had limited participation from this part of the population. This study is intended to fill a substantial "gap" in previous feedback from studies that were not designed specifically for Electronics Technology graduates. Chapter III will deal with the Methods and Procedures of this study.

CHAPTER III

METHODS AND PROCEDURES

This chapter will provide detailed information on the population of the study, the survey instrument design, and its use. The collection of data and its statistical analysis is also described.

POPULATION

The population of this study was all of the individuals that graduated from the PVCC Electronics Technology degree program from 1995-1999. Population data were obtained from the PVCC Office of Institutional Research and from recent PVCC commencement booklets. The entire population of this study was included in the study, since the total number was only 57 (PVCC Commencement Booklets, 1995-1999). Table 1 shows the distribution of this population with respect to year of graduation. Of the 57 graduates, 9 were female.

Table 1
Number of PVCC Electronics Graduates per Year 1995-1999

Graduation Year	1995	1996	1997	1998	1999
Number of Graduates	6	12	14	12	13

INSTRUMENT DESIGN

The instrument was designed based on a survey that was previously used by the PVCC Office of Institutional Research. While maintaining the same general format, the instrument was modified to meet the goals of this specific study by asking questions

pertaining to current employment in Electronics (or a related) occupation, the perceived level of workplace preparation, and questions about preparation in specific Electronics Technology skill areas. The introductory part of the first section of the survey contained three Yes/No questions dealing with current employment in Electronics and continuing education at a four-year institution. The questions that followed dealt with the perceived level of workforce preparation and satisfaction in various Electronics Technology skill areas which required a forced choice response based on the Likert scale, where "Very Satisfied" rated the highest score of 5 ranging down to "Very Dissatisfied" with a score of 1. The second section of the survey also included job-specific questions pertaining to the respondent's current employer and concluded with an open-ended comment section. A copy of the survey instrument is included in Appendix A.

METHODS OF DATA COLLECTION

The surveys were mailed to the population of the study with a cover letter in late September. Returned surveys were automatically forwarded to the PVCC Office Institutional Research. These surveys were periodically retrieved from this office by the researcher.

A list was maintained showing which students had responded. Any non-respondents were sent a follow-up letter and another survey approximately two weeks later. Attempts were made to contact any non-respondents by telephone approximately two weeks after the second mailing. A sample cover letter is provided in Appendix B, while the follow-up letter from the second mailing is included in Appendix C.

STATISTICAL ANALYSIS

A spreadsheet program was utilized to track the individual student responses for each question. One measure of central tendency was used to provide a statistical analysis of the respondent data. The mean was determined using a calculator for the Likert scale forced choice question results. The mean was later verified for all data using the averaging function on a computer spreadsheet program. The open-ended responses were also recorded for each participant in the study.

SUMMARY

This chapter has provided detailed information about the study's population. The details of the design and the instrument were then described. Data collection and statistical analysis were also outlined. Chapter IV will discuss the findings of the research study.

CHAPTER IV

FINDINGS

This chapter presents the findings of this study. The problem of this study was to determine the effectiveness of the Piedmont Virginia Community College (PVCC) Electronics program between 1995-1999. The statistical results of the survey for PVCC Electronics Technology graduates from 1995-1999 will be reported. PVCC Institutional Research results will also be provided for some of the similar questions on a recent yearly follow-up survey of all graduates.

The survey was divided into two main sections. The first section included questions about employment in Electronics and whether the graduate was continuing his/her education at a four-year institution. A Likert scale forced choice response question was also included in the first section to determine the graduate's perceived level of workforce preparation. The second section of the survey was dedicated to rating skill usage on the job in various content areas of the Electronics degree program and how well the graduates felt they were prepared for each. Graduates were also asked to provide their employer's name, length of employment, and approximate yearly income. The second section of the survey concluded with an open-ended comment section.

Thirty-four surveys were returned from the fifty-seven graduates included in the study. Table 2 shows the return rate as a percentage.

Table 2
Number of Graduates Responding To Questionnaire

Total Number of Graduates Surveyed	Number of Responses	Return Rate Percentage
57	34	59.6%

SECTION ONE SURVEY RESULTS

The first three questions in the first section of the survey asked the graduate questions about employment in their field of study and whether the graduate was continuing his/her education at a four-year institution. The first question was used to determine if the graduate was employed in an electronics related career. The results of the first question are shown in the Table 3.

Table 3
Responses to Question #1 in Section One of the Survey

Question	Answered Yes	Answered No	Percentage Employed in Electronics Related Career
1. Are you currently employed in an electronics related career?	27	7	79.4%

The second question was used to determine if a degree was required to obtain the job or promotion. The results of the second question are shown in Table 4. One respondent noted that although they indicated "No" in their response, the degree helped them get the job.

Table 4
Responses to Question #2 in Section One of the Survey

Question	Answered Yes	Answered No	No Response	Percentage that required degree from PVCC for job/promotion (%)
2. If "Yes" in #1, was a degree from PVCC required to obtain this job (or promotion)?	19	10	5	65.5%

The third question was used to determine if the student was continuing his/her education at a four-year institution. The results of the third question are shown in Table 5.

One respondent noted that although he/she indicated "No" in their response, the degree helped get the job.

Table 5
Responses to Question #3 in Section One of the Survey

Question	Answered Yes	Answered No	Percentage currently continuing education at four-year institution
3. Are you currently continuing your education at a four-year institution?	6	28	17.7%

Two respondents who indicated that they were not currently employed in an Electronics related career in the first question answered "Yes" to the third question related to continuing their education at a four year institution. Therefore, the total percentage of respondents who are currently employed in Electronics or who are continuing their education at a four-year institution is 85.3%.

The PVCC Institutional Research database was consulted for information about graduate attendance at four-year schools. The most recent graduate survey information (which includes graduates from all disciplines) was obtained for May 1998 graduates. The survey data for 1998 graduates showed that 38.4% of them were attending a four-year school.

The last question contained in the first section of the questionnaire asked the graduate to indicate their overall satisfaction with the level of workforce preparation that the PVCC Electronics program has provided. It required a forced choice response based on the Likert scale where "Very Satisfied" rated the highest score of 5, "Moderately Satisfied" rated a score of 4, "Neutral" rated a score of 3, "Moderately Dissatisfied" rated a score of 2, down to "Very Dissatisfied" with a score of 1. The results are shown in Table

6 where "Very Satisfied" is indicated by VS, "Moderately Satisfied" is indicated by MS, "Neutral" is indicated by N, "Moderately Dissatisfied" is indicated by MD, "Very Dissatisfied" is indicated by VD, and no response to the question is indicated by NR.

Table 6
Responses to Question #4 in Section One of the Survey

Question	Response						Mean
	VS	MS	N	MD	VD	NR	
4. Overall, how satisfied are you with the level of workforce preparation that the PVCC Electronics program has provided?	21	11	1	1	0	0	4.53

SECTION TWO SURVEY RESULTS

Most of the second section of the survey was dedicated to having students rate their preparation in various content/skill areas of the Electronics degree program. These skill areas included AC and DC Circuits, Electronic Devices, Microprocessors, Electrical Machines, Electrical Control Systems/PLCs, Digital Electronics/Computers, Test Equipment Usage, Electronic Communications, and Troubleshooting Skills. Each skill area required a forced choice response based on the Likert scale where "Very Satisfied" rated the highest score of 5, "Moderately Satisfied" rated a score of 4, "Neutral" rated a score of 3, "Moderately Dissatisfied" rated a score of 2, down to "Very Dissatisfied" with a score of 1. The results are shown in Table 8 where "Very Satisfied" is indicated by VS, "Moderately Satisfied" is indicated by MS, "Neutral" is indicated by N, "Moderately Dissatisfied" is indicated by MD, "Very Dissatisfied" is indicated by VD, and no response to the question is indicated by NR. The results are summarized in Table 7.

Table 7
Responses to Question #5 in Section Two of the Survey

Question: Please indicate your level of satisfaction with the preparation that the PVCC Electronics program has provided you in the following Electronics skill areas:	Response (Point Score)						Mean
Skill Areas	VS (5)	MS (4)	N (3)	MD (2)	VD (1)	NR	
AC & DC Circuits	24	9	0	1	0	0	4.65
Electronic Devices	24	9	0	1	0	0	4.65
Microprocessors	19	10	4	1	0	0	4.38
Electrical Machines	8	13	8	3	1	1	3.73
Electrical Control Systems/PLCs	12	10	7	2	1	2	3.94
Digital Electronics/Computers	23	9	1	1	0	0	4.59
Test Equipment Usage	20	10	2	1	0	1	4.48
Electronic Communications	16	12	4	1	0	1	4.30
Troubleshooting Skills	21	6	6	1	0	0	4.38

The remaining questions in the second section of the survey were related to the employment of the graduates. Table 8 shows the current employer for the graduates. Only students who indicated that they were currently employed in an Electronics related career were included in these results.

Table 8 Responses to Question 6 in Section Two of the Survey listing current Employer		
Employer Name	Number of Graduates Employed	Percentage of Respondents Employed by each Employer
3W Electronics	2	7.4%
Banta Book Group	1	3.7%
Clear Communications	2	7.4%
Comdial	2	7.4%
CSX Transportation	1	3.7%
Dept. of the Army NGIC	1	3.7%
GE Fanuc Automation	8	29.6%
Klockner Pentaplast	1	3.7%
Litton Marine Systems	5	18.5%
National Optronics	1	3.7%
Piedmont Networking Associates	1	3.7%
PVCC	1	3.7%
UVA Med. Ctr. Renal Unit	1	3.7%

The survey also asked the graduates to provide their approximate yearly income. Some graduates did not respond to this question. Using the graduates who responded to this question that were currently employed in an Electronics related career (graduates that responded "Yes" to Question #1 in Section I) the average, minimum, and maximum yearly incomes are summarized in Table 9. All of the yearly incomes reported by the graduates that are currently employed in an Electronics related career are provided in Appendix D.

Table 9
Responses to Question 6 in Section Two of the Survey listing approximate yearly income

Average Income	Minimum Reported Income	Maximum Reported Income
$31,735	$20,000	$48,000

The PVCC Institutional Research database was consulted for salary information similar to the results from the sixth question in the second section of the survey. The most recent graduate survey annual salary information (which includes graduates from all disciplines) was obtained for May 1998 graduates. Only salary information from graduates that indicated a full time work status (thirty-one hours or more per week) was used. All of the reported yearly incomes from graduates in this category are listed in Appendix E. The average income for the May 1998 graduates (from all disciplines) who indicated a full time employment status and who were working thirty-one hours per week or more was $27,260.

The last part of the survey concluded with an open-ended comment section. Eleven of the respondents provided some kind of comments on the survey. These comments are included in Appendix F.

SUMMARY

This chapter has presented the results of the PVCC survey for Electronics Technology graduates from 1995-1999. These survey results will be used to answer the three research goals of this study. Chapter V will discuss the summary, conclusions, and recommendations for this study.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter contains three main sections. The first part of this chapter will summarize the first four chapters. Conclusions will then be drawn followed by recommendations for the future.

SUMMARY

The problem of this study was to determine the effectiveness of the Piedmont Virginia Community College (PVCC) Electronics program between 1995-1999. The goals of this study were to answer the following three questions:

- Did the students find employment (or earn a promotion) in an Electronics related career upon graduation?
- Did the students feel that the Piedmont Virginia Community College (PVCC) Electronics program provided them with an adequate level of workplace preparation?
- What aspects of the Electronics program could be changed to better prepare future students for the workplace?

More up-to-date information is needed to verify an adequate level of workforce preparedness of recent graduates of the Electronics program. Feedback from the graduates can be used to implement curricular changes and help justify equipment purchases and funding. This study will provide information that will help ensure that the college's Electronics Technology graduates are receiving transferable skills and knowledge that can

be applied in the workplace.

There were three main limitations of this research study:

- The study will focus on degree recipients from Piedmont Virginia Community College (PVCC).
- The study will consider PVCC graduates from the time span of 1995-1999.
- The study will focus on Electronics Technology degree program graduates only.

The population of this study included all of the individuals that graduated from the PVCC Electronics Technology degree program from 1995-1999. The population included 57 graduates.

An existing PVCC Office of Institutional Research graduate survey was modified to meet the goals of this specific study by asking questions pertaining to current employment in Electronics (or a related) occupation, the perceived level of workplace preparation, and questions about preparation in specific Electronics Technology skill areas. The introductory part of the first section of the survey contained three Yes/No questions dealing with current employment in Electronics and continuing education at a four-year institution. The following questions dealt with the perceived level of workforce preparation and satisfaction in various Electronics Technology skill areas which required a forced choice response based on the Likert scale where "Very Satisfied" rated the highest score of 5 ranging down to "Very Dissatisfied" with a score of 1. The second section of the survey also included job-specific questions pertaining to the respondent's current employer and concluded with an open-ended comment section. A copy of the survey

instrument is included in Appendix A.

The survey instruments were mailed to the population of the study with a cover letter in late September. A sample cover letter is included in Appendix B. Returned surveys were automatically forwarded to the PVCC Office Institutional Research where they were periodically retrieved by the researcher. Any non-respondents from the first mailing were sent a follow-up letter and another survey in the middle of October. A sample follow-up letter from the second mailing is included in Appendix C. Attempts were made to contact any non-respondents by telephone approximately two weeks after the second mailing. Thirty-four surveys were returned from the fifty-seven graduates included in this study resulting in a return rate of 59.6%.

One measure of central tendency was used to provide a statistical analysis of the respondent data. The mean was determined using a calculator for the Likert scale forced choice question results. The mean was later verified for all data using the averaging function on a computer spreadsheet program. The open-ended responses were also recorded for each participant in the study.

CONCLUSIONS

This section will answer each of the research goals based upon the results of analyzed data.

Research Goal #1: Did the students find employment (or earn a promotion) in an Electronics related career upon graduation?

Survey results from Question #1 in Section One of the survey showed that 79.4% of the respondents were employed in an Electronics related career. This indicated

that most (approximately eight out of every ten survey respondents) graduates found employment in an Electronics related career.

Research Goal #2: Did the students feel that the Piedmont Virginia Community College (PVCC) Electronics program provided them with an adequate level of workplace preparation?

Survey results from Question #4 in Section One shows that the mean response of the overall satisfaction of the respondents with the level of workforce preparation from the PVCC Electronics program was 4.53. Based on the Likert scale, this value is in between 4 (Moderately Satisfied) and 5 (Very Satisfied). The mean response of the respondents resides in between "Moderately Satisfied" and "Very Satisfied" with the value being slightly directed toward "Very Satisfied." Graduates bordered on feeling "Moderately/Very Satisfied" with their level of workplace preparation.

Research Goal #3 What aspects of the Electronics program could be changed to better prepare future students for the workplace?

Survey results from Question #5 in Section Two provided means for the level of satisfaction with the preparation that the PVCC Electronics provided in several different skill areas. AC and DC Circuits, Electronic Devices, Digital Electronics and Computers were rated with means greater than 4.5 which indicates that the graduates were "Very Satisfied." Microprocessors, Test Equipment Usage, Electronic Communications, Troubleshooting Skills, Electrical Machines, and

Electrical Control Systems/PLCs were rated with means between 3.5 and 4.5 which indicate that the graduates were "Moderately Satisfied." The means of 3.73 for Electrical Machines and 3.94 for Electrical Control Systems/PLCs were significantly lower. This indicates that the Electrical Machines and Electrical Control Systems/PLCs courses may need to be altered to better prepare students for the workplace.

RECOMMENDATIONS

Based upon the results of this study, the following recommendations are made:

- Evaluate the textbooks, laboratory assignments, laboratory equipment, instruction, and curricular content of the Electrical Machines and Electrical Control Systems/PLCs courses in an effort to improve their transferability to the workplace environment.
- In an effort to increase the level of workforce preparation in all Electronics skill areas, increase collaboration with the Electronics industry in the college's service area to ensure that what is being taught in the classroom environment is transferable and meets the needs of the workplace.
- Implement follow-up studies for Electronics graduates every two or three years to provide more timely feedback to the college.
- Continue to coordinate with local Electronics industry employers and Electronics advisory committee members to obtain graduate placements.

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Appendix A
Survey Instrument

Piedmont Virginia Community College
Student Survey for Electronics Technology Graduates from 1995-99

Instructions: Please check the appropriate box for each question. This information will be treated as strictly confidential with answers being combined for group analysis.

1. Are you currently employed in an Electronics related career? Yes ❑ No ❑

2. If "Yes" in #1, was a degree from PVCC required to obtain this job (or promotion)? Yes ❑ No ❑

3. Are you currently continuing your education at a four-year institution? Yes ❑ No ❑

4. Overall, how satisfied are you with the level of workforce preparation that the PVCC Electronics program has provided?

Very Satisfied	Moderately Satisfied	Neutral	Moderately Dissatisfied	Very Dissatisfied
❑	❑	❑	❑	❑

5. Please indicate your level of satisfaction with the preparation that the PVCC Electronics program has provided you in the following Electronics skill areas:

Skill Areas	Very Satisfied	Moderately Satisfied	Neutral	Moderately Dissatisfied	Very Dissatisfied
AC & DC Circuits	❑	❑	❑	❑	❑
Electronic Devices	❑	❑	❑	❑	❑
Microprocessors	❑	❑	❑	❑	❑
Electrical Machines	❑	❑	❑	❑	❑
Electrical Control Systems/PLCs	❑	❑	❑	❑	❑
Digital Electronics/Computers	❑	❑	❑	❑	❑
Test Equipment Usage	❑	❑	❑	❑	❑
Electronic Communications	❑	❑	❑	❑	❑
Troubleshooting Skills	❑	❑	❑	❑	❑

6. Please list your current employer name, length of employment, and approximate yearly income below:

Employer Name: _____ Length of Employment: _____

Approximate Yearly Income: _____

Please use the reverse side of this survey to make any written comments about the quality of your educational experience in the Electronics Technology degree program. Feel free to comment on facilities, equipment, etc.

Ref. # [SSN]

BEST COPY AVAILABLE

Appendix B
Cover Letter

September 1, 1999

<<FNAME>> <<INITIAL>>. <<LNAME>> <<SUFFIX>>
<<STREET>>
<<CITY>>, <<STATE>> <<ZIP>>

Dear <<FNAME>>:

One of the best sources of information available to PVCC is a follow-up survey that is periodically sent to program graduates. As one of over fifty graduates of the Electronics Technology degree program from the past five years, you can provide valuable feedback that can be used to help implement any needed curricular changes. Your feedback can also be used to help justify purchasing decisions on new equipment and determine the need for new or revised courses.

I strongly encourage you to participate in this study. It will take no more than ten minutes of your time. Your responses to this survey will remain confidential, and only summarized data for the group of participating graduates as a whole will be published. Your social security number at the bottom corner of the survey is being used ONLY to assist PVCC in determining which graduates have responded.

For your convenience, I have enclosed a stamped, self-addressed envelope. I sincerely appreciate your participation in this important study and look forward to receiving your completed survey.

Sincerely,

Mark Fitzgerald
Program Head and Assistant Professor
Electronics Technology

Appendix C
Follow-Up Letter

October 10, 1999

«FNAME» «INITIAL» «LNAME» «SUFFIX»
«STREET»
«CITY», «STATE» «ZIP»

Dear «FNAME»

Approximately two weeks ago I wrote asking you to complete and return a graduate follow-up survey designed to provide information on how well the PVCC Electronics program prepared you for your current occupational career. As I wrote in the letter accompanying the questionnaire, we need that information to help determine the need for curricular changes and new or revised courses.

If you have already completed and returned the questionnaire, please disregard this letter. However, if you have *not* completed and returned the questionnaire, please assist PVCC by doing so. The questionnaire will take only a few minutes of your time to complete. Your responses to this survey will remain confidential, and only summarized data for the group of participating graduates as a whole will be published. Your social security number at the bottom corner of the survey is being used ONLY to assist PVCC in determining which graduates have responded.

For your convenience, I have enclosed another postage paid, self-addressed envelope for the survey. I sincerely appreciate your participation in this important study and look forward to receiving your completed survey.

Sincerely,

Mark Fitzgerald
Program Head and Assistant Professor
Electronics Technology

Appendix D

Yearly Income of Graduates in Electronics Related Career

Yearly Income of
Graduates In
Electronics
Related career

$20,000
$22,000
$24,000
$24,000
$25,000
$25,000
$26,000
$30,000
$30,000
$30,000
$30,000
$32,000
$32,000
$32,000
$33,000
$34,632
$35,000
$35,000
$35,000
$39,000
$40,000
$40,000
$40,000
$48,000

Appendix E

Yearly Income of Graduates (all disciplines) from May 1998 Follow-Up Survey

Annual Salary from 1998 Graduates (all Disciplines)
$0
$0
$17,000
$18,000
$18,000
$19,000
$19,260
$20,000
$20,800
$21,000
$21,000
$21,900
$22,000
$22,900
$26,000
$27,000
$27,500
$28,000
$29,000
$29,000
$30,000
$30,698
$30,699
$31,000
$31,000
$32,000
$32,000
$33,000
$34,000
$34,000
$34,424
$35,000
$36,000
$38,000
$40,000
$40,000
$43,000
$43,680

Appendix F
Respondent Comments

Unedited Student Comments:

Would like to see more on AC and DC motor control drives.

I continuously look for an electronics jobs and apply for the majority of them. The opportunity of finding a electronics job and not a electrician job is slim in this area. And because of the lack of jobs in this area (C'ville, Richmond, Culpeper, H'burg, Waynesboro), I feel that this is my problem, not PVCC. [student name signed]

Without any doubt getting the degree opened doors to me. Overal, I think the work did very well to prepare me for industry. I would only offer that (because I went into Electronic component sales) coursework in Administration, office relations, personal communication skills should also be focused on. ie, General Business Skills! At the time there was no computer comm. or network type course work offered. I see that has now changed.

Need 2 semesters [of Electronic Communications]

Overall my experience at PVCC was great. Mark Fitzgerald is a great asset to the Electronics program at PVCC. It would be great if PVCC could find other instructors as dedicated to the Electronics program. Patrick [adjunct faculty member] is also a good adjunct instructor. Be good to them because they do really care about their students and their students' success.

Prior to my employment at Litton Marine Systems, I was employed at Klockner Pentaplast. There I served as Lead Electronics Technician working extensively with PLC's, DC Motors/Drives and other Microprocessor Control Systems. Piedmont played an integral part in allowing me to perform my job and excel with the company. [student name signed]

It is hard to be objective when rating the classes. I tend to give a higher rating to the ones that interested me more. And I am sure I put forth more effort in the ones that held my interest to a higher degree. I can say that overall, my experiences at PVCC led me to a greater understanding in my job. Our labs provided us with hands-on training in the use of test equipment. The labs were my greatest source of frustration. It seems that many of the students were interested in "hurrying up" to finish the labs and go home. I found that "rushing" did not help me at all, but if I didn't go with the rest, I quickly fell behind. So my greatest struggle was to "keep up". I don't think I absorbed as much as I could have if I could have gone at my own pace and really thought about what I was doing and why. However, there was not enough equipment to allow students to work alone, which could have been of benefit to me and to other students.

Sorry I did not get a chance to return your letter, earlier. I would like to recommend some things that would have given me a better perspective. The first one would be to have a more updated microprocessor class. That would get into more depth about the registers

and how all the supporting chips (flash, Sram, Dram) around the processor interact together. The second thing would be to have a better understanding from the AC&DC circuits. It would help I believe if PVCC could purchase some type of product for the students to analyze. Such as looking through the schematics and seeing how Engineers interface everything together. Example, a telephone system. Where you have lines and stations that come into a system and how they are linked together with different types of circuits. I think this could also be used as a very good way of showing how to trouble shoot problems. Overall, I think the Electronics program gives you a good background for a job as an electronic technician. I would also like to recommend that your letter to be sent out after about 2 years because it is hard remembering everything that went on in the classes. Therefore, it is hard giving you comments. [student name signed on company letterhead]

The program was exactly what I wanted. Except for one class with a book I did not like, I would have to say that everything was rather perfect.

Mark Fitzgerald does an excellent job of collecting information of job opportunity.

Needs more hands on experience with incorporating theory with actual real life projects.

I would rate the classes taught by Mark Fitzgerald very high. However, classes taught by the temporary "staff" have been less than desirable. I many cases, these instructors would learn how to teach the class half way through the semester. This would not be so bad if they would come back to teach again. I strongly recommend adding a full time instructor to work with Mark. [student name signed]

The reason for no employment, I'm still attending PVCC to transfer to a Four year university. Now I'm studying towards a Computer Engineering Degree. Overall, I really like the lectures and a lot lab hours (hands on experience) which followed the lectures very closely.